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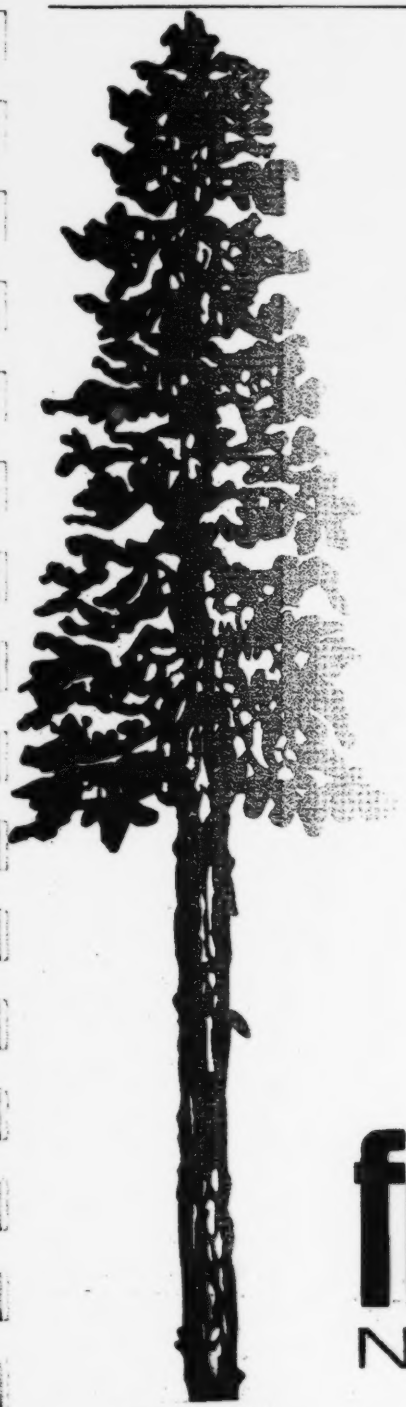

Forests Greater Than 140 Years Old In the Kootenay-Boundary Region[1] -Status Report

H. J. Quesnel PhD PAg RPBio
and
J. K. Leahy RPF

Technical Report TR-004

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[1]This includes the Nelson Forest Region and Tree Farm Licences, national parks, and provincial parks within or adjacent to the forest region.

SUMMARY

Old growth is an important issue in forest management. It has been the subject of review papers and strategy development. The Old-Growth Task Force of British Columbia recommended that older forests should be inventoried; typical, rare, and rapidly decreasing old-growth types should be identified; and the maps and associated database should be used as input for local planning processes. The Protected Areas Strategy (PAS) includes old-growth as a conservation issue to be addressed. Identification and mapping of older age classes was undertaken as part of PAS. The focus has been on ecological units with rare, limited, or under-represented old growth.

A regional forest cover map was generated by combining existing electronic versions for timber supply areas (TSA) with paper map and remote sensing information from federal parks, provincial parks, and tree farm licences (TFL). Private land was not included. A geographical information system (GIS) was used to combine ecosection (1:600 000), biogeoclimatic (1:250 000), and forest cover (1:20 000) maps for the Kootenay-Boundary Region. For each ecosection, the database was summarized by forest cover within each biogeoclimatic subzone/variant. The following fields were extracted from the database: total area for all cover classes, area of age class 7 (121-140 yr), area of age classes 8 + 9 (>140 yr), and area of productive forest land. Area of age classes 8 + 9 as a percent of productive forest land was calculated. The GIS generated a 1:250 000 product map that identified older age classes and included biogeoclimatic and ecosection boundaries. The GIS also produced 1:50 000 scale maps and a database for areas within TSA boundaries.

Ecological units with forests >140 yr covering 10% or less of the productive forest land base were examined. These units were considered potential old-growth areas. Twenty-two units were identified as of concern to land managers because of relatively limited amounts of forests >140 yr. Units were also examined that had <1000 ha of >140 yr old forests although the percent of the productive forest land base covered was > 10%. Ten units were identified as of concern because the low area of these units makes them vulnerable to significant reduction or loss. For units with low percent or low actual area of older forests, it is recommended that map notations be placed to warn potential users that old-growth may be limited in these areas. It is also recommended that these units, where possible, be incorporated in special management areas such as old-growth reserves, ecosystem networks, or riparian zones.

A critical minimum level of old-growth is difficult to specify. Levels for age classes 8+9 are even more difficult to specify as these areas indicate potential old-growth, are not inventoried for ecological function, and mapping errors exist. Many natural and human factors affect the quantity of old-growth in an area. The quantity is decreased by timber harvesting and probably increased by fire suppression. Natural factors include stand-replacing fires, disease, insects, and geological processes. Low-intensity fire is needed for drier areas to maintain old-growth structures in these forests. These include snags and large, down logs used by wildlife species. These structures also provide aesthetic appeal for many people. Fire-maintained old-growth is a characteristic of stands with ponderosa pine and western larch.

Future work on old-growth should include stand verification and development of old-growth criteria. Landscape work should include guidelines on minimal area per ecological unit, range of patch sizes for older forests, and distribution of these stands across the landscape. Fire management prescriptions should be developed to maintain desired old-growth features in stands with natural low-intensity fires.

ACKNOWLEDGEMENTS

Several people should be acknowledged for making this study possible. Discussion and input from regional and district planners in the Nelson Forest Region resulted in the formation of an old-growth committee. Russ Hendry (Invermere) and T. Volkers (Cranbrook), provided valuable recommendations through the regional old-growth committee. H. Aumack provided valuable input for contract specifications, advice on geographical information systems, synthesis and summary of the database, and general advice on forest cover and other maps. M. Geisler and G. Darychuk provided financial support through the Integrated Resource Management Program, Nelson Forest Region. Digital Dimensions Inc., Victoria, manually aggregated paper-based maps and LANDSAT images for gaps in Tree Farm Liciences, provincial parks, and national parks. FORGIS Resource Consultants were responsible for digitizing, processing electronic map files, and generating databases for the 1:250 000 and 1:20 000 scale projects. A special thanks to J. Pollack for inspiration and steady support during the initial stages of this project.

The document has been greatly improved by critical review and input from Marvin Eng, Ministry of Forests, Victoria, Peter Lewis, Ministry of Forests, Kootenay Lake District, Nelson, and Al Soobotin, Ministry of Environment, Lands and Parks, Nelson. Ginny Garner, Debbie DeLong, and John Pollack, Ministry of Forests, Nelson provided useful editorial comments and assisted in the production of this document.

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INTRODUCTION

Old growth is an important public issue in forest management. Requirements for old growth have been recognized or specified for management plans in the Okanagan Timber Supply Area (B. C. Ministry of Forests 1992a) , Upper Carmanah Valley (Carmanah Valley Forest Management Advisory Committee 1992), and Prince Rupert Forest Region (Steventon 1992). A conservation and management plan has been implemented for the Robson Valley Forest District (B. C. Ministry of Forests 1992b). The Robson Valley plan includes a complete inventory of the major old growth areas remaining in the forest district and designation of these areas for special management. Old growth is an important component of biological diversity (biodiversity) (Pojar 1991). Areal requirements for old growth will be specified in coastal biodiversity guidelines (Coastal Biodiversity Guidelines Committee 1992). Similar requirements will likely exist in future interior biodiversity or fish, forestry, and wildlife guidelines.

The old-growth issue in British Columbia has been the focus of some review papers and a strategy development process. A problem analysis was undertaken by several members of the Ministry of Forests (Research Branch 1990). This review provided a synthesis of knowledge on old growth definitions, function, biodiversity relationships, and management. One objective was to determine the relevancy of old-growth research from the northwestern United States and Alaska. The review concluded that while research on old-growth in coastal Douglas-fir in Washington and Oregon was relevant in general, specific attributes over the biogeoclimatic zones of British Columbia would vary because of differences in climate, tree species, and physiography. The authors felt that the essential first step in old-growth research was to develop working definitions for describing these forests, particularly for forest types in areas with lots of pressure on old-growth from harvesting, urbanization, or other development. Working definitions were presented by the Old-Growth Task Force (B. C. Ministry of Forests 1992c). These definitions are based solely on minimum age criteria for various tree species in the forested biogeoclimatic zones. Separate age criteria were presented for coastal and interior forests. Other reviews have stated that definitions of old growth vary and consist of the following broad groups: economic, mensurational, conceptual/ecological, and spirtual/aesthetic (Hamilton and Pojar 1991; Pojar et al. 1990).

The Old-Growth Task Force (B. C. Ministry of Forests 1992) recommended that older forests in British Columbia should be mapped using the existing forest cover database. This group also recommended that old growth in existing protected areas be evaluated and inventoried. Combining these inventory projects would enable land managers to identify typical, rare, and rapidly decreasing old-growth types. This information would also indicate the magnitude, extent, and general distribution of the potential old-growth resource. The maps and database would also provide input for local planning processes such as Local Resource Management Planning.

On May 6, 1992, the government of British Columbia announced the development and implementation of a Protected Areas Strategy (PAS) for the province. PAS is to combine several conservation initiatives including the Old-Growth Strategy. As part of this process, a Regional Protected Areas Team (RPAT) was formed in Nelson for the Kootenay-Boundary Region. A regional old-growth committee was also struck by the Nelson Forest Region (NFR), Ministry of Forests. The committee consisted of representatives from district and regional planning staff. The committee's goal was to address the old-growth issue in a framework that would be acceptable to government, industry, and public groups. The committee's recommendations on criteria and value assessment for old-growth were forwarded to the Kootenay-Boundary RPAT for consideration in the PAS process. Based on these and recommendations from other government agencies, the Kootenay-Boundary RPAT undertook a project that generated maps and databases for the region (1:250 000) and for timber supply areas (TSA) (1:50 000).

The framework for assessing forest cover data was biogeoclimatic subzone/variants within ecosections. Biogeoclimatic units are described in Braumandl and Curran (1992)[2]. The ecoregion classification system for British Columbia, including a definition for ecosections and a provincial map, are described in Demarchi (1993), Demarchi and Lea (1992), and Demarchi et al. (1990)[3]. Within this ecological framework, forest cover polygons with stands >140 years old were identified. This age criteria best met the value recommended by Old-Growth Task Force (B. C. Ministry of Forests 1992c). Forest stands aged 121-140 years old were also identified and incorporated in the mapping and database production. The lower age class was identified because proximity of mature forests to

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[2]Appendix I lists the zones, subzones, and variants plus abbreviations for the Nelson Forest Region.
[3]Appendix II lists the ecoregion classification units plus abbreviations for the Kootenay-Boundary Region.

old-growth minimizes edge effects and enhances the ecological value of potential old-growth stands (Harris 1984). These stands also have potential to provide old-growth recruitment areas within a few decades.

METHODS

The mapping project was an overview using PAMAP®, a geographical information system (GIS). This project incorporated information from TSA's, tree farm licences (TFL), national parks, and provincial parks where forest cover or comparable natural resource inventories existed. Two large private landholdings, one near Kootenay Lake and the other near Cranbrook, were not included in the map generating exercise. Appropriate natural resource inventories were not available for these areas. Information on smaller private lands were also not available but the area involved was insignificant for a regional analysis.

The first step was to generate a common forest cover map for the above areas. With the exception of the two large private landholdings, this would yield a map for the region. Where available, 1:20 000 Ministry of Forests digital files and corresponding attributes were used to generate a forest cover map at a scale of 1:250 000. Gaps in the map and database existed for TFL's and parks. Gaps in TFL forest cover information were filled by taking existing 1:20 000 paper maps and manually assigning polygons an age class. For parks, gaps in forest cover information were filled by interpretting biophysical maps and satellite imagery, delineating polygons, and assigning age classes. The polygons for TFL's and parks were then digitized and a datafile was created for the polygons. All of the database information was merged into a common file and aggregated into the following groups: age classes 0-6 (<120 years), age class 7 (121 -140 years), age classes 8-9 (>140 years), and other nonforested areas such as swamp, urban, or cultivated.

The second step in the development of the maps and database was to overlay the above forest cover information with subzones/variants for each ecosection. A forest cover age class theme was produced at a scale of 1:250 000. Because of the reduction of some of the forest cover maps to the smaller scale 1:250 000 map, map information was lost for polygons approximately 50 ha or smaller in size. However, the information for these polygons was retained in the database and used in the analysis. The age of some of the forest cover information was several years old but was the most recent available. Subzone/variant maps (1:250 000) and ecosection maps (1:600 000) were then

electronically overlayed onto the regional forest cover map. For the biogeoclimatic maps, complex units with the AT zone, a nonforested unit, as the main component were simplifed by dropping the other components. The other components are minor and contain relatively small areas of forests. A forest cover class theme with biogeoclimatic and ecosection lines was generated for the Kootenay-Boundary Region at a scale of 1:250 000. The resultant database was organized by cover groups within the subzones/variants of each ecosection. The following information was extracted from the database and summarized for each subzone/variant within an ecosection: age classes 0-6, age class 7, age classes 8-9, total forest cover (total of age classes 0-9), and total area for all cover types. Age classes 8-9 as a percent of total forest cover was calculated for each subzone/variant within an ecosection.

A second set of maps at 1:50 000 scale and a database were produced for areas within TSA's. For the second mapping project, the same fields were extracted, the same summaries were generated, and the same calculations were performed as for the regional project. Age classes 8 and 9 (>140 yr) and age class 7 (121-140 yr) were color-themed on the 1:50 000 maps. Age class 7 was color-themed separately to indicate the landscape context of individual older stands (>140 yr) and to indicate potential old-growth recruitment areas.

RESULTS AND DISCUSSION

i. Regional Mapping Project

The results for the 1:250 000 mapping project (Table 1) provide a regional overview of the potential old-growth resource. This is considered the appropriate framework for assessing the resource because planning at provincial, regional, or local levels should incorporate old-growth in parks and wilderness. The results for TSA's from the 1:50 000 scale project are summarized and included in Appendix III. These results and maps are intended for locating stands, selecting stands for developing old-growth criteria, and for input into local or regional planning. These maps are available from regional or district offices of the Ministry of Forests. For most ecosections, the results are identical for both projects. The results vary for some subzones/variants in ecosections with significant areas of parks or TFL's. The results for the larger scale analysis of TSA's will not be discussed further in this report. A copy of the 1:600 000 scale ecosection map is included in the

back pouch of this report. Subzone/variant maps are available at district offices of the Ministry of Forests.

Area of productive forest land and age classes 8 + 9 as a percent of productive forest land are included in Table 1 (page 14) and Figures 1-7 (pages 17-23). These values should best reflect land capable of growing old-growth forests and the current value for each ecological unit, respectively. This approach should provide a more realistic analysis than simply calculating age classes 8 + 9 as a percent of total area for a subzone/variant within an ecosection. Nonproductive cover types such as swamp have low potential to yield old-growth. Some subzones/variants or site series within other subzones/variants have little if any capability of growing forests of any age class. For example, alpine tundra and adjacent parkland units have limited forest because of the cold environment. The driest site series in the PPdh1 variant is a natural grassland (Braumandl and Curran 1992). The reader should note that the values for age classes 8+9 in Table 1 reflect potential old-growth. For some ecological units, less potential old growth would be found because of initial inventory errors, recent harvesting, and natural disturbances. Also, age class alone does not define old growth. Thus, the values in Table 1 are optimistic and minimal levels of age classes 8+9 recommended for old-growth retention in a planning process may need to be increased until more accurate inventory data is available.

The question is often asked: what percent of the land should be in old-growth forests? The answer is of interest to those developing land management plans for provincial forests, to those providing input for nontimber resources, and to public groups evaluating the plans. An ecologially based answer is rarely available because of limited knowledge on natural disturbance regime in a subzone/variant or, if such information is available, process information is not available indicating future levels of old-growth required for various organisms. Managers often select a fixed but arbitrary value which will balance ecological values with other social values such as timber production. A value of 10% has been used as a minimal value in the Okanagan Timber Supply Area (B. C. Ministry of Forests 1992a). A similar value is recommended by the coastal biodiversity guidelines (Coastal Biodiversity Guidelines Committee 1992b). Ten percent of productive land base in older age classes will be used to assess the potential old-growth in the various units. As with earlier reports and studies, this value is arbitrary but it will give a basis for comparing the relative amounts in each ecological unit.

There are 26 units with 10% or less of age classes 8 + 9 in the productive forest land base (Table 1). Of these units, 13 had 5% or less of these age classes on the productive forest land base. The ESSFdkp and ESSFwcp variants in the CPK ecosection do not contain any area of productive forest land and should not be considered in the assessment for land capable of producing old-growth. In the BBT ecosection, the ESSFwc2 variant has 0% age classes 8 + 9 but this is a small unit (2 ha) that results when the broad scale ecosection map is overlain on the subzone and forest cover maps. This unit is also very extensive in the Kamloops Forest Region and can probably be ignored for the Kootenay-Boundary regional analysis. The ESSFdk subzone in the SCM ecosection is a small unit (33 ha) that also appears to be an artifact created by the map overlay process. Thus the units with 5 - 10% age classes 8 + 9 that should be of concern in the Kootenay-Boundary Region include:

i. BRR ecosection - ICHmk1 variant and MSdk subzone (Figure 1b);
ii. CCM ecosection - ICHdw subzone (Figure 2a);
iii. EKT ecosection - IDFdm2 variant and MSdk subzone (Figure 3b);
iv. MCR ecosection - ESSFwm subzone (Figure 4b);
v. SCM ecosection - ICHmk1 variant (Figure 6a);
vi. SFH ecosection - ICHdw subzone and ICHmw2 variant (Figure 6b); and
vii. SPK ecosection - ICHmk1 variant (Figure 7b).

The units with 5% or less age classes 8 + 9 that should be of concern include:

i. BBT ecosection - ESSFwm subzone (Figure 1a);
ii. EKT ecosection - ICHmk1 and PPdh2 variants, IDFun subzone (Figure 3b);
iii. EPM ecosection - ICHmw1 variant (Figure 4a);
iv. SCM ecosection - ICHdw, ICHxw, and MSdk subzones (Figure 6a);
v. SFH ecosection - ICHxw subzone and IDFdm1 variant (Figure 6b); and
vi. SPK ecosection - ICHmw1 and ICHmw2 variants (Figure 7b).

These units should be of concern to managers as they occur in relatively low quantities and the old growth component could be readily lost from the landscape. These units should be noted on maps to advise of potential old-growth limitations in the area. Old-growth, in addition to being an important general component of biodiversity, is often a specific requirement in landscape planning and minimal levels may be a requirement for future biodiversity guidelines. It is recommended that occurrence of these units be noted

and extensive disturbance by harvesting or other activities be minimized. Caution is recommended until specific policies concerning old-growth are developed. Specific policies could include interior fish, forestry, and wildlife guidelines, old-growth strategy for a specific forest district, or old-growth levels and other biodiversity guidelines developed for Local Resource Management Plans. The greatest danger is significant reduction or outright loss of these units in the interim. This may limit the options of land managers required to meet integrated resource management goals. For example, the draft Interior Fish, Forestry & Wildlife Guidelines state that 12% of the landscape should be age class 8 or older.

Assessment of areas by percent of age classes 8 + 9 is acceptable if all units are comparable in size. In this analysis, the size of units varies from a few hectares to close to half a million hectares (Table 1). A potential flaw in a comparison by percentages is that units with a high relative proportion of older age classes but small absolute values will be missed. These units should be indicated as they could easily be reduced or eliminated. This would limit or remove future options for land management. As indicated earlier for percent in age classes 8 + 9, it is difficult on an ecological basis to state a critical minimal level for old-growth. In this report, units with <1000 ha of these age classes will be examined. This is an arbitrary value selected for comparative purposes. Some of these units were highlighted earlier because of low percent cover of older age classes. Thus, we will examine units with 1000 ha or less of older age classes but >10% on an areal basis.

Of the units with >10% of age classes 8 + 9 on the productive forest land, 17 had 1000 ha or less (Table 1). Four of these units are alpine or parkland units. These include:

i. MCR ecosection - AT zone (Figure 4b);
ii. NOH ecosection - AT zone and ESSFdcp subzone (Figure 5b); and
iii. SPK ecosection - ESSFdkp subzone (Figure 7b).

As indicated earlier, cold temperatures limit occurrence and growth of trees in these higher elevation subzones/variants. These areas should not be considered part of the sustained yield forest. Assuming that disturbances such as timber harvesting or mining do not occur in these subzones/variants, old-growth levels should not be a management concern in these units.

Three of these units with <1000 ha of age classes 8 + 9 have small total area. These include:

i. CPK ecosection - ICHvk1 variant (Figure 3a); and
ii. NOH ecosection - ESSFwc4 and PPdh1 variants (Figure 5b).

These units appear to be artifacts created by the map overlay process involving the broadscale ecosection map. With the exception of PPdh1 variant in the NOH ecosection, all of these units cover large areas in adjacent ecosections and have large areas of age classes 8 + 9 on a percentage or absolute basis (Table 1). From the database, the cover classes for the PPdh1 variant in this ecosection are primarily cultivated or open rangeland which is not likely to yield old-growth forests. Thus, these three units are not of great concern for land managers unless they occur in a specific watershed or other planning unit and are included as part of an old-growth requirement.

This leaves ten units with <1000 ha but >10% age classes 8 + 9 of concern. These include:

i. CCM ecosection - ICHmk1 variant (Figure 2a);
ii. COC ecosection - MSdk subzone (Figure 2b);
iii. EKT ecosection - ESSFdk subzone (Figure 3b);
iv. EPM ecosection - ICHmk1 variant (Figure 4a);
v. MCR ecosection - ICHmk1 and ICHmw2 variants (Figure 4b);
vi. NOH ecosection - IDFxh1 variant (Figure 5b);
vii. SFH ecosection - MSdm1 variant (Figure 6b); and
viii. SOH ecosection - IDFxh1 and PPdh1 variants (Figure 7a).

Managers should also note these units on their maps and, where possible, include these units as part of old-growth reserves, forest ecosection networks, riparian management areas, or other special management zones. Although the percentage of these units is >10%, relatively low actual areas implies that potential old-growth in these units could be significantly reduced or even lost. This would obviously reduce or remove options for future resource management.

ii. Factors Affecting Quantity Of Old Growth

Human and natural factors affecting the amount of old-growth in the Kootenay-Boundary Region should be considered when evaluating Table 1 and when trying to determine the appropriate level for an ecological, watershed, or planning unit. As noted earlier, climate regime in terms of moisture and temperature play a general role in determining the natural levels of old-growth in an area. Thus one would expect less old-growth in drier PPdh subzones and AT zone in the mid-elevation ICHvk1 variant with lots of precipitation and moderate temperatures. These climatic variables affect quantities of old-growth directly through rate of tree growth and indirectly through frequency of stand-replacing fires.

The main human impacts affecting old-growth in the region are likely to be timber harvesting and fire suppression. The impact of the former process can be evaluated from harvesting records or by evaluating forest cover age classes that reflect historical patterns of harvesting in an area. The impact of this process is an obvious reduction of old-growth where clearcut logging has occurred. A more subtle negative impact has occurred in areas selectively harvested more than a few decades in the past. Current levels of large trees and snags may be below natural values because of past selective harvesting for large diameter trees. These structural attributes are critical wildlife attributes and are difficult to replace. The impact of fire suppression is more difficult to assess although superfically it would appear to be a postitive impact in terms of areas that reach or are maintained in old-growth forests. However, a study on old-growth ponderosa pine (*Pinus ponderosa*) in Glacier National Park, Montana found that maintenance of this stand type would require periodic low-level ground fire. This type of disturbance provides germination opportunites for the pine, reduces the fuel loading and risk of catastrophic fire, and reduces invasion by Douglas-fir and Engelmann spruce (*Picea engelmannii*) (Lunan and Habeck 1973). In a review article, Habeck (1990) describes old-growth stands of ponderosa pine and western larch in western Montana as fire-dependent. These stands r uire low-level ground fires every few years to a few decades to maintain the desired stand structure. Fire suppression for several decades yields stands with greater fuel loadings of other species such as Douglas-fir (*Pseudotsuga menziesii*). The result is a greater probability of a catastrophic stand-replacing fire and total loss of desired old-growth stand attributes.

The role of fire and other natural disturbances in maintaining old-growth stands in the NFR must be recognized and included in management plans for maintaining the desired

stand attributes. Natural fire regime in the Rocky Mountains appears to be frequent low intensity underburns every few years to a decade with stand-replacing fires occurring at intervals of several decades to a few hundred years (Arno 1980; Barrett, Arno, and Key 1991). The fire regime varies with subzones/variants as these reflect differences in climatic regime (Braumandl and Curran 1992). Low intensity, more frequent underburning typifies the PP zone, the IDF zone, and the drier variants in the ICH. Stands in the MS zone, ESSF zone, and the wetter ICH zone have had greater influence from stand-replacing fires of lower frequency. The result is lower density, more open stands in the drier subzones/variants, higher density stands in the wetter units, and extensive stands of lodgepole pine reflecting stand-replacing fires in the MS zone (Braumandl and Curran 1992). Fire frequencies and intensities are tabulated in Research Branch (1990). The fire regime in the Rocky Mountains contrasts with coastal Douglas-fir where the fire regime is characterized by even less frequent but more intensive fires (Hemstrom and Franklin 1982). The natural fire regime in the Rocky Mountain area probably results in old-growth stands with smaller live trees, smaller snags, and smaller accumulations of decaying wood. In the wetter subzones/variants with lower fire frequency, disturbance due to insects, disease, and windthrow have greater impact between fire events. The forest health agents operating in these subzones/variants are listed in Braumandl and Curran (1992) and Research Branch (1990).

Because of the variety of natural and man-induced processes operating on the landscape combined with our relatively limited knowledge of ecological processes and associated organisms, it is difficult, if not impossible, to provide an ecological answer to the levels of old-growth that should be part of a management area. The answer may ultimately depend on the supply of structural attributes that provide habitat for a variety of organisms and determine the background levels of many ecological processes. Wildlife use associated with structural attributes such as large trees, snags, coarse woody debris, multiple-layered canopies, and canopy gaps has been the focus of several studies and reviews (Bunnell and Allaye-Chan 1987; Franklin et al. 1981; Harmon et al. 1986; Mannon and Meslow 1984; Maser et al. 1979; Thomas et al. 1979). These studies emphasize that old-growth stands are important for wildlife because of the presence of relatively high concentrations of trees, snags, and woody debris with dimensions that tend to be in the largest size classes found in natural systems. This principle appears to hold for the NFR as demonstrated by a recent study near Kootenay Lake. Steeger and Machmer (1993) found that the majority of wildlife trees used were >40 cm in diameter and at least 15-20 m in height.

The value of stand structures will obviously vary with organisms in an area and also with fire regime. It is possible that old-growth value can be retained or compensated by retention of attributes in second growth stands. Wildlife tree and coarse woody debris can be retained as part of biodiversity guidelines. Thus, the important concept in old-growth management may be to define the requirements for structural attributes at the stand level and to specify landscape organization and distribution for these attributes.

Landscape planning for old growth should probably occur at the watershed or planning unit basis within an ecosection. Ecosection summaries should be used to keep the local planning process in perspective. At the local level, proper old-growth distribution can be attained by stratifying an area by subzones/variants. This should provide a useful mechanism as these ecological units are stratified by elevation, aspect, slope, and other factors (Braumandl and Curran 1992) that affect distribution and use by organisms. Stratification should be modified as appropriate to reflect special wildlife use or other local values

RECOMMENDATIONS FOR FUTURE WORK

The maps were produced with little or no field sampling. Stands identified by the mapping project should be ground-truthed to verify if they meet minimal standards for old-growth. The age criteria provided by the Old-Growth Task Force (B. C. Ministry of Forests 1992c) are the simplest and probably the best to use until more refined criteria are developed. Ground-truthing could identify stands recently harvested, affected by natural disturbances, or included because of errors in the initial forest inventory. These stands would no longer be considered as potential old growth. Stand inspection would also provide the opportunity to collect data for developing more specific old-growth criteria. Criteria to evaluate should include: number and species of large trees or snags greater than a minimal dbh, quantity and piece size for coarse woody debris, presence/absence of patches, type of stand layering, and disturbance regime. These variables were suggested in the problem analysis of Research Branch (1990). Old-growth criteria should be developed with two objectives. The criteria should reflect the biological use of the site by trees, other plants, animals, and other organisms. For example, how valuable for animal species are areas designated for old-growth if the slopes are predominantly >80% (P. Lewis, 1993, pers.comm.)? Will these sites be of limited value for large mammals or other species groups ? Stands should be examined to determine use by ungulates, other

mammals, birds, and other animal species. The second objective is to provide criteria that can be readily used for verification by operational personnel.

This project is a regional overview. It is one framework for addressing the old-growth issue. It may not provide the necessary detail for all issues in a forest district or for development of local management plans within districts. Ecosection and biogeoclimatic boundaries do not convieniently correspond to TSA boundaries. An obvious extension of the present project is to extend the framework to the forest district inventory and planning process (P. Lewis, 1993, pers. comm.). Ecosection and biogeclimatic map and database information could be combined with inventory databases to generate old-growth maps for a forest district. These maps could provide input for district and watershed plans. These maps could also be readily updated as part of ongoing forest reinventory programs.

Future activities at the landscape level require the development of criteria or guidelines on minimal area of old-growth within different ecological units, average or range of size for functional old-growth, and distribution of stands in the different ecological units. These three variables vary with subzone/variant and between ecosection. For example, drier sites in the PPdh in the natural state would contain lower areas of old-growth, different patch size, and different distribution of patches when compared to stands of ESSFvc with greater precipitation and lower fire frequency. Landscape level recommendations would be invaluable input when planning for biodiversity at this level. Forest managers must have some idea of how to plan for old-growth within a landscape context. Landscape requirements for mature and older forests are included in coastal biodiversity guidelines (Coastal Biodiversity Guidelines Committee 1992). Interim guidelines for old-growth in interior forests should be developed pending fish, forestry, and wildlife guidelines or other biodiversity guidelines for these areas. Landscape recommendations for old-growth should vary by subzone/variant within ecosections to reflect differences in natural processes.

A final area for future research is the development of fire management programs for old growth or potential old-growth in areas that have higher fire frequency. Research cited earlier indicates that low intensity underburns or even localized higher intensity burns are needed in many areas to maintain stand structural attributes needed by many wildlife species. Many of these structural attributes, such as large ponderosa pine or western larch in a relatively open stand with grasses and other herbaceous species, provide much of the aesthetic appeal of these sites to humans. Improvement in basic understanding of fire

disturbance regime and associated impacts on stand structures are needed to achieve the fire management objectives in areas managed or maintained for old-growth. As an interim strategy, it is recommended that the ability to manage for old-growth attributes needs to be demonstrated prior to the widespread application of burning techniques. Retention of areas for old-growth will be needed until attribute management is demonstrated.

TABLE 1. Old-Growth Data - Kootenay Region[a]

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
BBT	ESSFwc2	2	0	0	1	0.0
	ESSFwm	1 330	5	7	1 260	0.6
	ICHmw1	73 415	2 379	8 634	56 950	15.2
	ICHvk1	4 319	58	2 478	4 071	60.9
	ICHwk1	28 011	329	8 248	14 519	56.8
BRR	AT	56 820	335	4 380	8 122	53.9
	ESSFdk	220 125	1147	40 880	158 569	25.8
	ESSFwm	37 536	591	9 424	23 911	39.4
	ICHmk1	34 022	210	1 771	26 884	6.6
	ICHmw2	4 129	7	1 115	3 693	30.2
	IDFdm2	4 204	210	1 473	3 119	47.2
	MSdk	63 248	511	4 980	52 638	9.5
CCM	AT	370 343	5538	72 491	99 865	72.6
	ESSFwc4	379 157	12 975	150 477	281 087	53.5
	ESSFwm	125 555	4 170	48 858	94 280	51.8
	ICHdw	80 215	8 856	3 761	57 181	6.6
	ICHmk1	4 610	616	664	3 737	17.8
	ICHmw2	467 480	28 179	85 410	393 699	21.7
	ICHmw3	55 934	2 310	11 003	40 094	27.4
	ICHwk1	47 137	380	19 960	40 342	49.5
COC	AT	9 120	3	1 334	1 907	70.0
	ESSFdk	44 657	1 037	11 627	31 313	37.1
	MSdk	5 125	152	556	4 242	13.1
CPK	AT	277 044	150	14 190	16 275	87.2
	ESSFdk	12 434	0	4 829	4 829	100.0
	ESSFdkp	102	0	0	0	N/A[d]
	ESSFwc2	44 090	443	21 170	24 965	84.8
	ESSFwcp	166	0	0	0	N/A
	ESSFwm	81 257	519	21 592	37 452	57.7
	ICHmw1	50 236	683	12 006	34 427	34.9
	ICHvk1	8	0	2	2	100.0
	ICHwk1	29 487	239	16 307	20 745	78.6
EKT	ESSFdk	2 187	217	244	2 143	11.4
	ICHmk1	24 124	489	498	19 825	2.5
	IDFdm2	279 074	9 209	19 746	203 354	9.7
	IDFun	21 650	70	45	10 807	0.4
	MSdk	51 506	3 997	4 297	48 969	8.8
	PPdh2	73 858	1 412	2 116	44 204	4.8
EPM	AT	282 006	1 039	43 076	56 075	76.8
	ESSFdk	219 918	7 277	61 703	165 960	37.2
	ESSFwm	59 932	3 084	17 740	34 065	52.1
	ICHmk1	722	1	116	669	17.3
	ICHmw1	15 515	165	516	14 558	3.5

TABLE 1. (Continued).

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
EPM	IDFdm2	7 478	620	1 317	6 331	20.8
	MSdk	54 886	1 674	7 861	49 915	15.7
MCR	AT	872	0	415	726	57.2
	ESSFdk	97 376	4 633	13 180	94 500	13.9
	ESSFwm	16 222	488	1 316	15 541	8.5
	ICHmk1	3 963	20	653	3 709	17.6
	ICHmw2	5 583	29	717	5 472	13.1
	IDFdm2	20 738	718	2 680	18 783	14.3
	MSdk	87 574	2 511	9 561	84 936	11.3
NCM	AT	593 618	2 102	83 333	95 965	86.8
	ESSFwc2	29 859	249	13 760	17 585	78.2
	ESSFwc4	119 949	1 573	59 815	73 817	81.0
	ESSFwcp	3 445	8	1 175	1 236	95.1
	ESSFwm	45 908	606	22 743	31 696	71.8
	ESSFvc	246 718	1 471	135 062	160 674	84.1
	ICHmw1	6 337	0	5 250	6 154	85.3
	ICHmw2	21 847	522	5 215	16 060	32.5
	ICHmw3	5 073	55	1 856	4 463	41.6
	ICHvk1	88 542	545	50 594	66 412	76.2
	ICHwk1	171 751	989	82 787	134 561	61.5
NOH	AT	155	0	153	155	98.7
	ESSFdc1	13 550	488	5 133	13 024	39.4
	ESSFdcp	422	2	95	319	29.8
	ESSFwc4	24	8	3	24	12.5
	ICHmk1	34 933	2 415	6 509	33 132	19.6
	IDFdm1	112 472	7 377	20 455	97 847	20.9
	IDFxh1	2 568	213	203	1 722	11.8
	MSdm1	118 672	3 644	26 053	115 042	22.6
	PPdh1	52	0	1	6	16.7
SCM	AT	38 982	1 587	15 750	25 436	61.9
	ESSFdk	33	16	0	33	0.0
	ESSFwc4	93 638	2 450	27 404	76 549	35.8
	ESSFwm	110 525	3 955	21 569	100 031	21.6
	ICHdw	115 284	2 024	2 745	72 633	3.8
	ICHmk1	7 416	95	544	5 415	10.0
	ICHmw2	167 660	3 857	16 590	151 848	10.9
	ICHxw	37 379	401	508	10 082	5.0
	MSdk	13 740	0	180	13 514	1.3
SFH	AT	23 916	880	9 842	15 105	65.2
	ESSFdc1	60 325	2 169	21 999	57 412	38.3
	ESSFwc4	125 652	6 812	29 005	115 586	25.1
	ICHdw	195 680	12 279	11 339	147 841	7.7
	ICHmk1	66 529	4 493	7 332	64 500	11.4

TABLE 1. (Concluded).

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
SFH	ICHmw2	276 955	16 382	23 713	256 848	9.2
	ICHxw	4 201	57	64	2 721	2.4
	IDFdm1	2 354	42	7	1 697	0.4
	IDFun	4 943	93	1 037	3 345	31.0
	MSdm1	1 462	0	421	1 459	28.9
SOH	ICHmk1	3 447	187	1 014	3 281	30.9
	IDFdm1	13 770	611	1 219	8 446	14.4
	IDFxh1	17 752	950	970	8 875	10.9
	PPdh1	13 751	266	322	2 179	14.8
SPK	AT	360 782	2 126	78 264	95 919	81.6
	ESSFdk	482 545	19 420	234 601	395 409	59.3
	ESSFdkp	1 251	3	259	295	87.8
	ESSFwm	49 615	1105	10 150	37 073	27.4
	ICHmk1	26 080	748	2 168	23 335	9.3
	ICHmw1	3 854	104	103	3 674	2.8
	ICHmw2	2 298	111	37	2 160	1.7
	IDFdm2	12 763	2 645	1 941	11 658	16.6
	MSdk	165 990	14 938	58 896	155 258	37.9

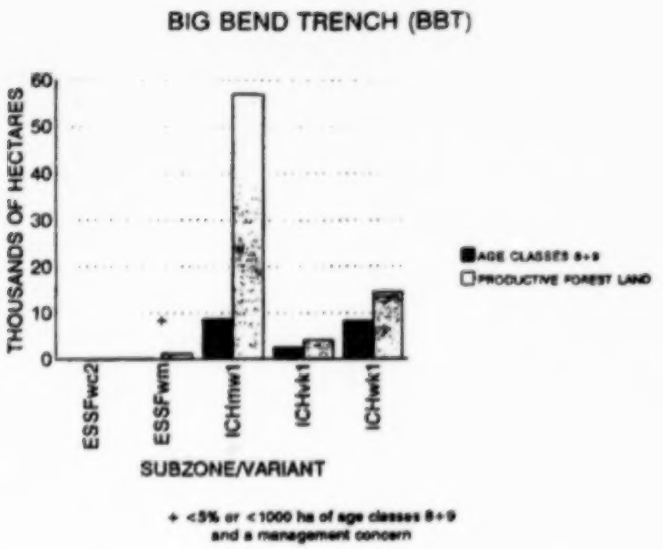
[a] This includes Timber Supply Areas, Tree Farm Licences, national parks, provincial parks, and other protected areas. Two large private holdings near Cranbrook and Kootenay Lake are not included because natural resource inventories are not available.

[b] Productive forest land includes age classes 0-9. It does not include nonproductive area such as swamp, alpine, or water.

[c] Percent age classes 8 + 9 = [(age classes 8 + 9)/(productive forest land)] X 100%.

[d] This unit does not contain area capable of yielding productive forests. Tree cover is sporatic and mainly consists of krumholz.

a.



b.

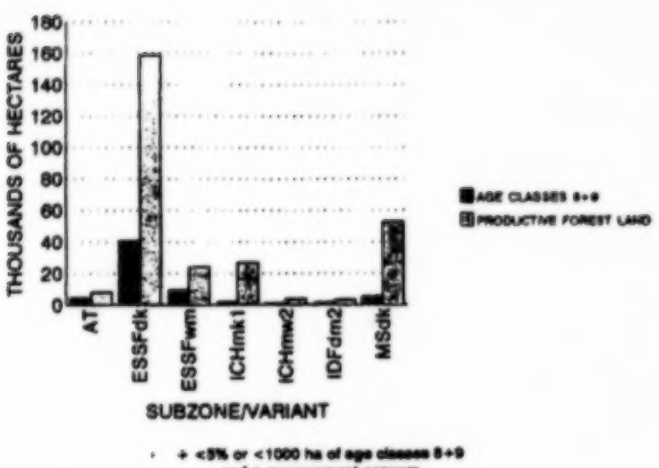
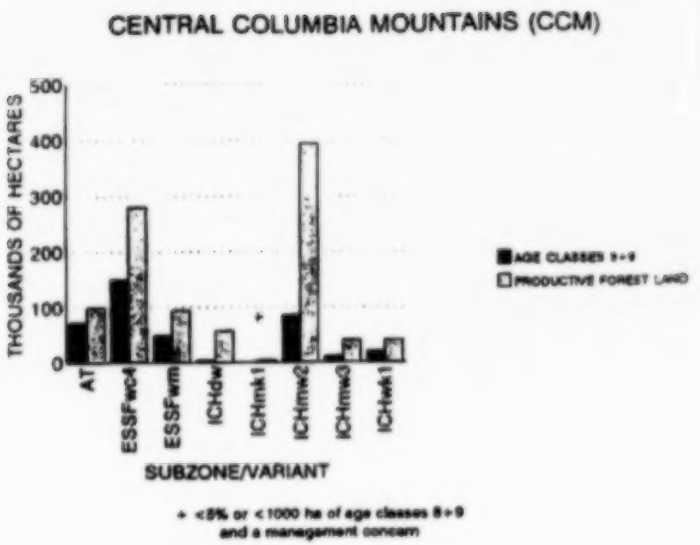


Figure 1. Status of potential old growth by biogeoclimatic subzone/variant for the Big Bend Trench (a) and Border Ranges (b) ecosections.

a.



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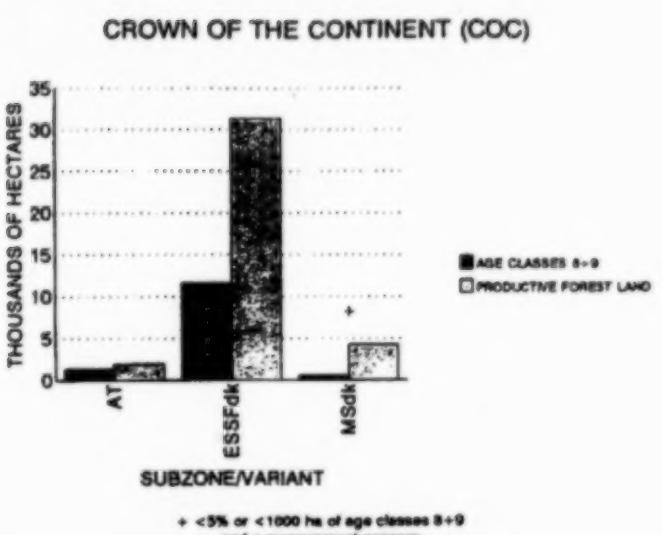
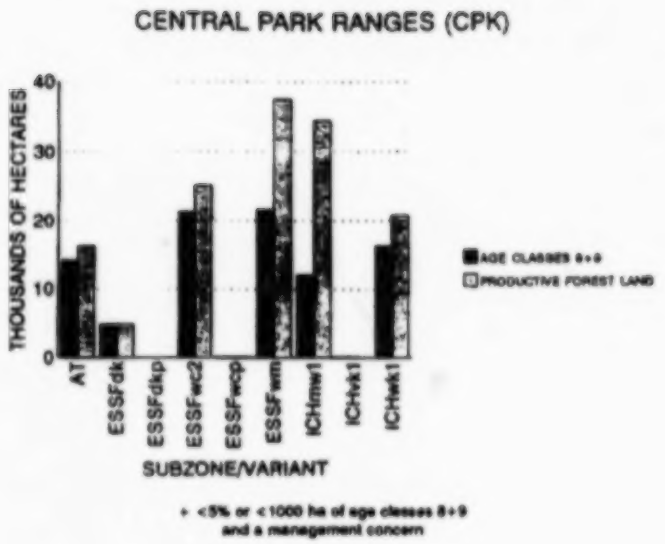


Figure 2. Status of potential old growth by biogeoclimatic subzone/variant for the Central Columbia Mountains (a) and Crown Of The Continent (b) ecosections.

a.



b.

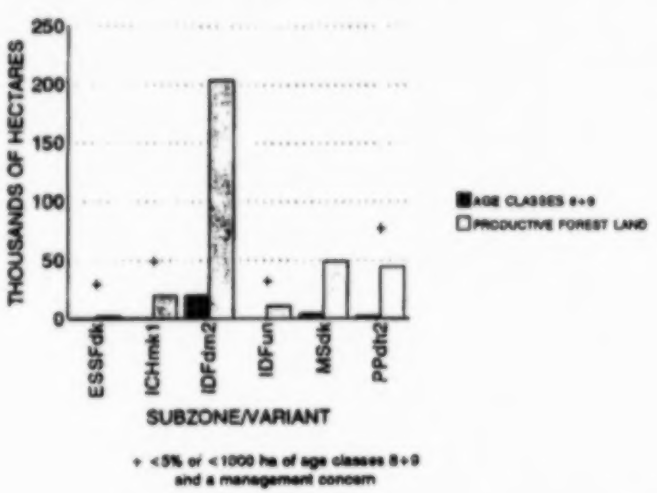
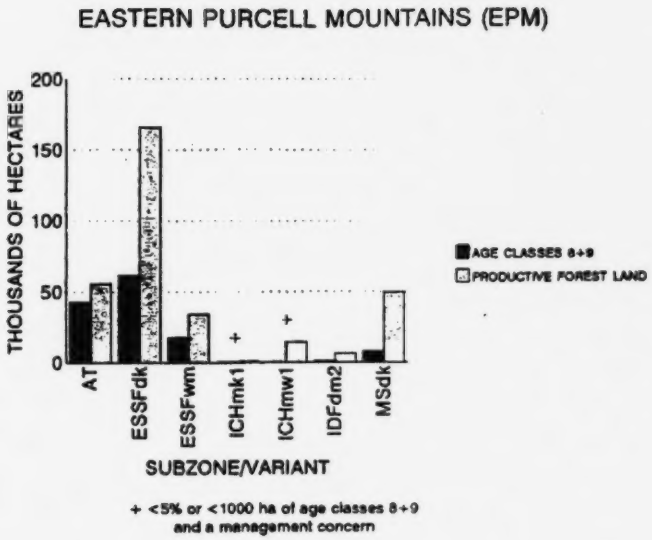


Figure 3. Status of potential old growth by biogeoclimatic subzone/variant for the Central Park Ranges (a) and East Kootenay Trench (b) ecosections.

a.



b.

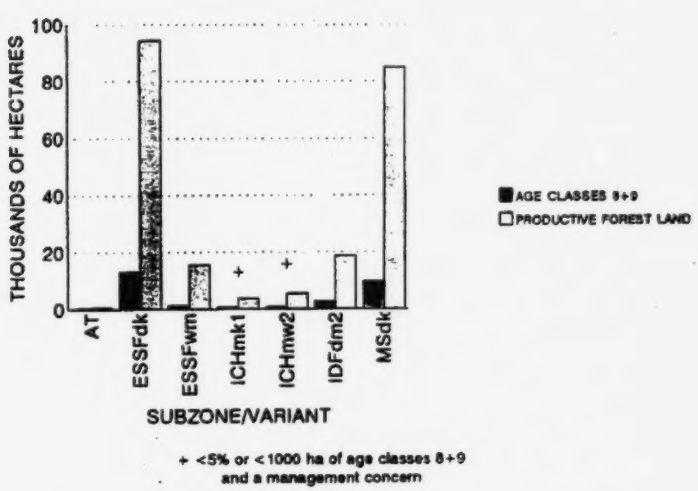
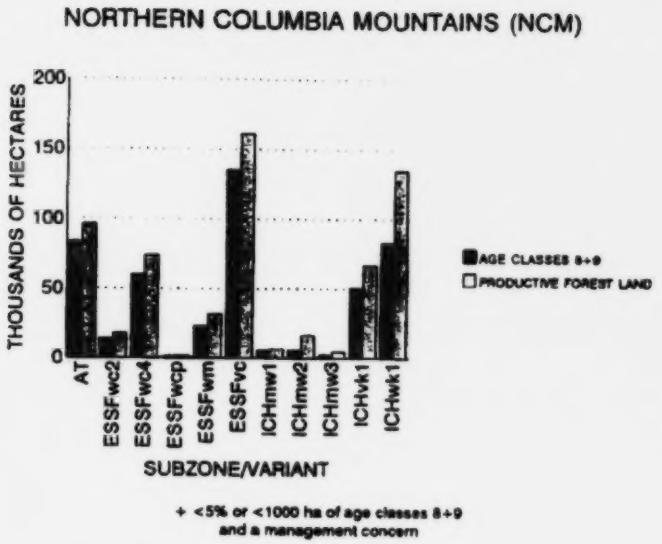


Figure 4. Status of potential old growth by biogeoclimatic subzone/variant for the Eastern Purcell Mountains (a) and McGillivray Range (b) ecosections.

a.



b.

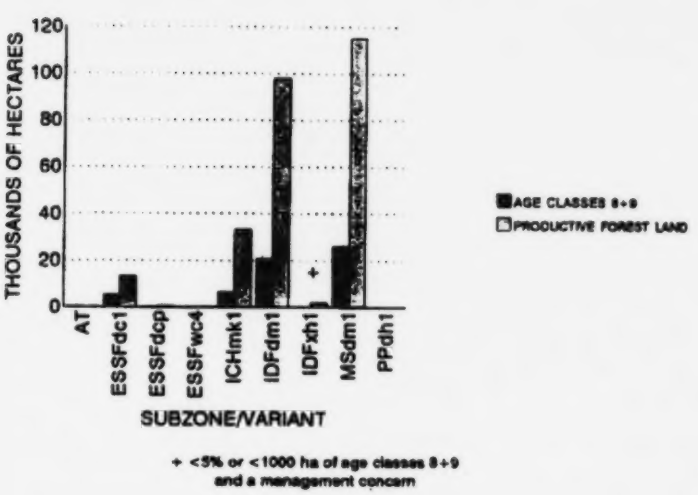
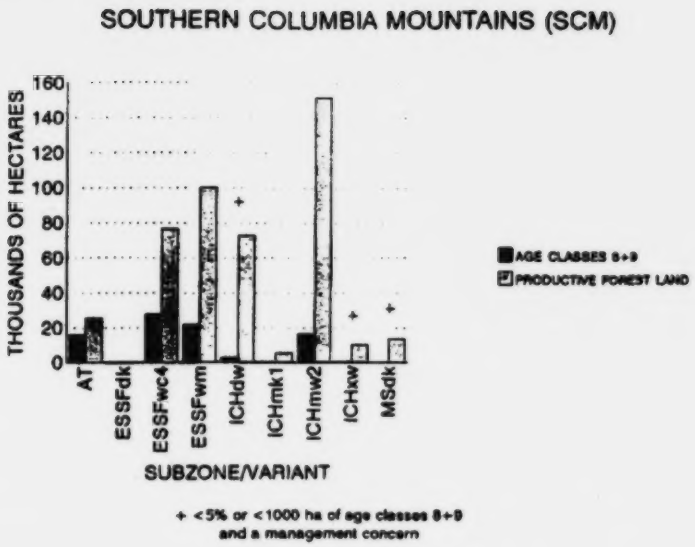


Figure 5. Status of potential old growth by biogeoclimatic subzone/variant for the Northern Columbia Mountains (a) and Northern Okanagan Highlands (b) ecosections.

a.



b.

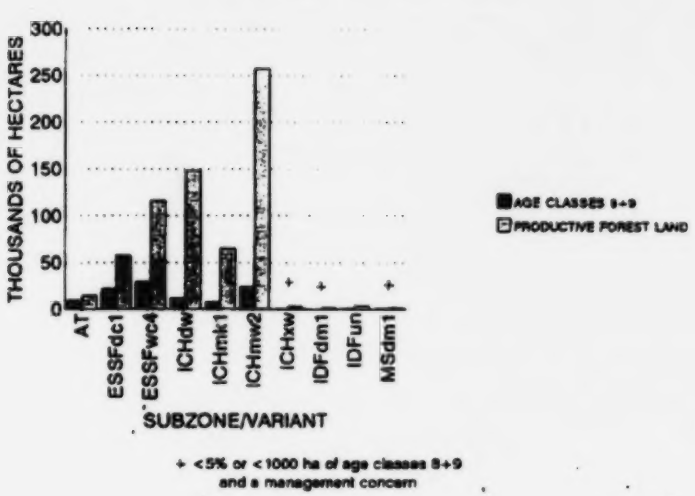
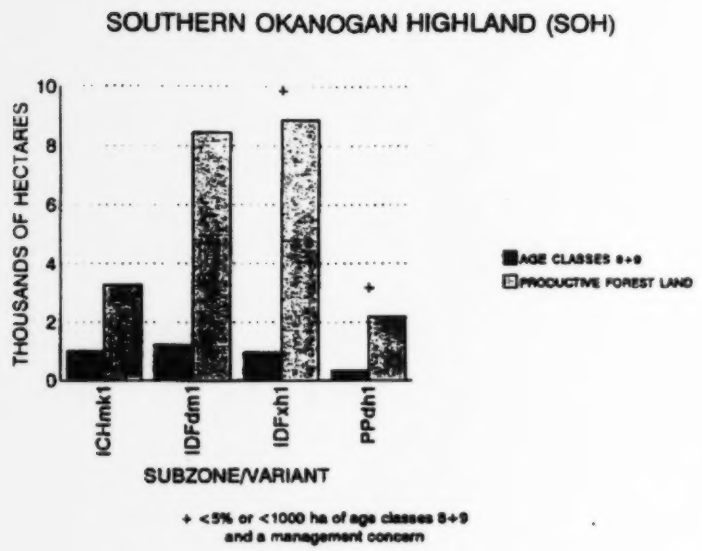


Figure 6. Status of potential old growth by biogeoclimatic subzone/variant for the Southern Columbia Mountains (a) and Selkirk Foothills (b) ecosections.

a.



b.

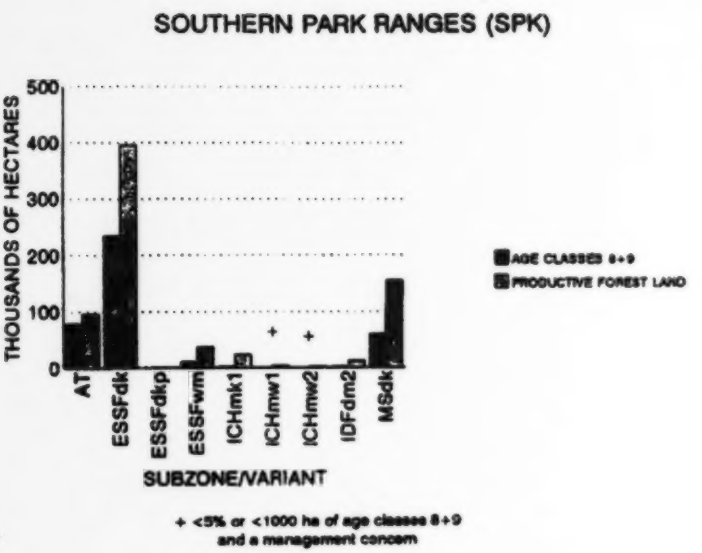


Figure 7. Status of potential old growth by biogeoclimatic subzone/variant for the Southern Okanogan Highland (a) and Southern Park Ranges (b) ecosections.

APPENDIX I. Subzone/variant names, tree species, and elevation[a]

Biogeo-climatic zone	Climate region	Abbrevi-ation	Subzone/ variant	Tree species[b]	Elevation ranges S=South aspect N=North aspect
PP Ponderosa Pine	Dry	PPdh1	Kettle Dry Hot Ponderosa Pine Variant	**Py, Fd** At, Ac, Sxw, (Lw[c]), [-Pl[d]]	500-950m^S
	Dry	PPdh2	Kootenay Dry Hot Ponderosa Pine Variant	**Py, Fd** Sxw, At, Ac, (Lw, Pl)	700-950m^S
IDF Interior Douglas-fir	Dry	IDFxh1[e]	Okanagan Very Dry Hot Interior Douglas-fir Variant	**Fd, Py** At, Ep, (Lw) [-Pl]	500-1200m^S 500-1050m^N
	Dry	IDFun	Undifferentiated Interior Douglas-fir Subzone	**Fd**	
	Dry	IDFdm1	Kettle Dry Mild Interior Douglas-fir Variant	**Fd** Lw, Pl, Py, Sxw, At, Ac, Ep, (Cw)	500-1370m^S 500-1280m^N
	Dry	IDFdm2	Kootenay Dry Mild Interior Douglas-fir Variant	**Fd** Py, Lw, Pl, Sxw, At, Ac, (Ep)	800-1200m^S 800-1100m^N
ICH Interior Cedar - Hemlock	Moist	ICHxw	Very Dry Warm Interior Cedar - Hemlock Subzone	**Cw, Bg** Lw, Fd, Pl, Py, Sxw, At, Ac, Ep, Bl, Hw, Pw	450-1100m^S
	Moist	ICHdw	Dry Warm Interior Cedar - Hemlock Subzone	**Hw, Cw, Ac, (Bl)** Lw, Fd, Pl, Py, Sxw, Pw, Bg, Ep, At	450-1200m^S 450-1000m^N
	Moist	ICHmw1	Golden Moist Warm Interior Cedar - Hemlock Variant	**Hw, Cw** Fd, Pl, Sxw, Pw, Ep, Ac, (Bl), [-Lw]	750-1550m^S 750-1500m^N
	Moist	ICHmw2[f]	Columbia-Shuswap Moist Warm Interior Cedar - Hemlock Variant	**Hw, Cw** Fd, Pl, Pw, Sxw, At, Lw, Ac, Ep, Bl, [-Bg, -Py]	500-1450m^S 500-1400m^N
	Moist	ICHmw3[g]	Thompson Moist Warm Interior Cedar - Hemlock Variant	**Hw, Cw** Fd, Pl, Pw, Sxw, Bl, At, Ep, Ac, [-Lw]	400-1400m^S 400-1350m^N
	Moist	ICHmk1	Kootenay Moist Cool Interior Cedar - Hemlock Variant	**Cw, Sxw** Lw, Fd, Pl, Py, Ep, At, Ac, Bl, (Pw, Hw)	800-1550m^S 750-1500m^N

APPENDIX I. (Continued)

Biogeo-climatic zone	Climate region	Abbrevi-ation	Subzone/ variant	Tree species[b]	Elevation ranges S=South aspect N=North aspect
ICH Interior Cedar - Hemlock	Wet	ICHwk1	Wells Gray Wet Cool Interior Cedar - Hemlock Variant	**Hw, Cw** Fd, Bl, Sxw, Ep, Ac, Pw, (Lw, Pl, At)	400-1400m^{S} 400-1350m^{N}
	Wet	ICHvk1	Mica Very Wet Cool Interior Cedar - Hemlock Variant	**Hw, Cw** Fd, Pw, Sxw, Ep, Ac, (Bl, At), [-Pl, -Lw]	550-1350m^{S} 550-1350m^{N}
MS Montane Spruce	Dry	MSdk	Dry Cool Montane Spruce Subzone	**Se, Bl, (Fd)** Fd, Pl, Lw, At, Ac, Ep, (Sw, Cw)	1200-1650m^{S} 1100-1550m^{N}
	Dry	MSdm1	Okanagan Dry Mild Montane Spruce Variant	**Se, Bl, (Fd)** Ac, Ep, (Sw)	1370-1650^{S} 1280-1550m^{N}
ESSF Engelmann Spruce - Subalpine Fir	Dry	ESSFdk	Dry Cool Engelmann Spruce - Subalpine Fir Subzone	**Se, Bl,** Pa, Pl, La, At, (Fd[d], Lw[d])	1650-2100m^{S} 1550-2100m^{N}
	Dry	ESSFdkp	Dry Cool Parkland Engelmann Spruce - Subalpine Fir Subzone	**Se, Bl** Pa, La	2100-2600m^{S} 2100-2600m^{N}
	Dry	ESSFdcl	Okanagan Dry Cold Engelmann Spruce - Subalpine Fir Variant	**Se, Bl** Pl, (Pa, At)	1650-1950m^{S} 1550-1950m^{N}
	Moist	ESSFwm	Wet Mild Engelmann Spruce - Subalpine Fir Subzone	**Bl, Se** (Hw, Pw, Pl, Lw)	1600-1950m^{S} 1500-1950m^{N}
	Moist	ESSFwmp	Wet Mild Parkland Englemann Spruce - Subalpine Fir Subzone	**Bl, Se** Pa, La	1950-2600m^{S} 1950-2600m^{N}
	Moist, Wet	ESSFwc1	Columbia Wet Cold Engelmann Spruce - Subalpine Fir Variant	**Se, Bl** Hw, Cw, Pl, (Fd, Pw, Lw, Pa)	1450-1650m^{S} 1400-1600m^{N}
	Moist, Wet	ESSFwc2[e]	Northern Monashee Wet Cold Engelmann Spruce - Subalpine Fir Variant	**Se, Bl** Pl (Fd)[d]	1450-1800m^{S} 1400-1800m^{N}
	Moist, Wet	ESSFwc4	Selkirk Wet Cold Engelmann Spruce - Subalpine Fir Variant	**Se, Bl** Pl, Pa	1650-1950m^{S} 1600-1950m^{N}

APPENDIX I. (Concluded)

Biogeo-climatic zone	Climate region	Abbrevi-ation	Subzone/ variant	Tree species[b]	Elevation ranges S=South aspect N=North aspect
ESSF Engelmann Spruce - Subalpine Fir	Moist, Wet	ESSFwcp	Wet Cold Parkland Englemann Spruce - Subalpine Fir Subzone	**Se, Bl** La, Pa	1950-2440m^{S} 1950-2400m^{N}
	Wet	ESSFvc	Very Wet Cold Engelmann Spruce - Subalpine Fir Subzone	**Se, Bl, Hm** (Cw[g], Hw[g])	1350-1800m^{S} 1250-1800m^{N}
	Wet	ESSFvcp	Very wet Cold Parkland Engelmann Spruce - Subalpine Fir Subzone	**Se, Bl, Hm** Pa	1800-2300m^{S} 1800-2300m^{N}
AT Alpine Tundra	Dry, Moist, Wet	AT			Min. Elev. 2600 m in Dry Region; 2400 m in Moist Region; 2300 m in Dry Region

[a] Table extracted from Braumandl and Curran (1992).
[b] Species in bold are zonal climax, all non-bold species are seral or non-zonal species.
[c] ( ) Bracketted species are rare species.
[d] [-] Square brackets and minus sign denote diagnostic absence of species.
[e] Please refer to Kamloops Forest Region Fieldguide (Lloyd et al., 1990) for site identification and management interpretations for the IDFxh1, ICHmw3, and ESSFwc2. These variants of limited extent in the Nelson Region.
[f] The southern portion of this variant is found above the ICHdw, i.e., at elevations of 1200-1550 m.
[g] Occur in the lower elevations of the subzone/variant.

APPENDIX II. Ecosections Of The Kootenay-Boundary Region[a]

ECOSECTION ABBREVIATIONS

Ecoprovince	Ecoregion	Ecosection	Map symbol
SOUTHERN INTERIOR MOUNTAINS	COLUMBIA MOUNTAINS AND HIGHLANDS	Central Columbia Mountains	CCM
		Eastern Purcell Mountains	EPM
		McGillivray Range	MCR
		Northern Columbia Mountains	NCM
		Southern Columbia Mountains	SCM
	NORTHERN CONTINENTAL DIVIDE	Border Ranges	BRR
		Crown of the Continent	COC
	SELKIRK - BITTERROOT FOOTHILLS	Selkirk Foothills	SFH[b]
	SOUTHERN ROCKY MOUNTAIN TRENCH	Big Bend Trench	BBT
		East Kootenay Trench	EKT
	WESTERN CONTINENTAL RANGES	Central Park Ranges	CPK
		Southern Park Ranges	SPK
SOUTHERN INTERIOR	OKANOGAN HIGHLAND	Southern Okanogan Highland	SOH
	THOMPSON - OKANAGAN PLATEAU	Northern Okanagan Highland	NOH

[a] The region includes areas evaluated by the Kootenay Regional Protected Areas Team. The boundary corresponds to the Nelson Forest Region and includes provincial parks, national parks, and other areas not in the Ministry of Forests administrative area. The region includes the Kootenay Region and the southeast portion of the Southern Interior Region, Ministry of Environment.

[b] SBF was used as the abbreviation for this ecosection in earlier documents.

Demarchi (1993) provides the following definitions:

> "**Ecoprovinces** - are areas of consistent climate or oceanography, and physiography. They are useful for subcontinental, national or provincial-overview planning. There are ten for the province (of British Columbia), nine terrestrial and one marine.
>
> **Ecoregions** - are areas with major physiographic, minor microclimatic or oceanographic differences within each ecoprovince. Ecoregions can be used to group biogeoclimatic or marine zones for the determination of historical and potential distribution of vegetation and wildlife. As such they are useful in provincial level planning. There are 43 ecoregions in British Columbia.
>
> **Ecosections** - are areas with minor physiographic, climatic and oceanographic differences. Each ecosection has a unique sequence of biogeoclimatic sub-zones and marine zones. This level in the hierarchy is useful for regional resource planning. There are 110 ecosections in British Columbia, 10 that are mainly marine, another 18 have both marine and terrestrial ecosystems, and 82 are strictly terrestrial."

Biophysical and recreational features for each ecosection in the Kootenay-Boundary Region are described in:

> Quesnel, H. J. and F. N. Thiessen. 1993. Ecosection summaries for the Kootenay-Boundary Region. B. C. Min. For., Forest Sciences and Recreation Sections, Tech. Rep. TR-003, Nelson, B. C.

APPENDIX III. Old-Growth Data - Timber Supply Areas, Nelson Forest Region[a]

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
BBT	ESSFwm	1 330	5	7	1 250	0.6
	ICHmw1	73 417	2 379	8 430	56 930	14.8
	ICHvk1	4 319	58	2 478	4 071	60.9
	ICHwk1	27 595	329	7 935	14 196	55.9
BRR	AT	47 647	106	3 784	7 030	53.8
	ESSFdk	213 095	739	39 336	150 979	26.1
	ESSFwm	37 535	591	9 424	21 991	42.9
	ICHmk1	31 762	207	1 764	22 680	7.8
	ICHmw2	4 130	7	1 115	2 386	46.7
	IDFdm2	4 204	210	1 473	3 095	47.6
	MSdk	63 251	511	4 980	49 293	10.1
CCM	AT	197 823	4 337	55 019	75 365	73.0
	ESSFwc4	190 957	7 865	70 205	145 843	48.1
	ESSFwm	98 844	3 880	39 654	80 169	49.5
	ICHdw	64 951	7 166	2 662	42 395	6.3
	ICHmk1	4 610	616	664	3 738	17.8
	ICHmw2	305 800	16 418	48 237	241 438	20.0
	ICHmw3	35 567	1 782	5 548	20 951	26.5
	ICHwk1	9 054	174	2 247	6 341	35.4
COC	AT	9 121	3	1 334	1 908	69.9
	ESSFdk	44 658	1 037	11 628	30 858	37.7
	MSdk	5 125	152	556	4 165	13.3
CPK	AT	243 991	150	13 037	15 123	86.2
	ESSFwcp	166	0	0	0	N/A[d]
	ESSFwc2	42 355	443	20 673	24 466	84.5
	ESSFwm	81 261	519	21 426	37 292	57.5
	ICHmw1	50 238	683	12 007	33 519	35.8
	ICHvk1	8	0	2	2	100.0
	ICHwk1	29 488	239	16 308	20 733	78.7
EKT	ESSFdk	2 184	215	244	2 140	11.4
	ICHmk1	23 556	489	496	19 014	2.6
	IDFdm2	274 212	8 756	19 258	196 917	9.8
	IDFun	21 651	70	45	10 801	0.4
	MSdk	41 238	3 320	3 281	38 721	8.5
	PPdh2	73 860	1 412	2 116	43 424	4.9
EPM	AT	178 586	710	35 574	46 639	76.3
	ESSFdk	163 217	2 700	47 265	126 904	37.2
	ESSFwm	17 745	167	6 808	13 574	50.2
	ICHmw1	15 512	165	516	14 287	3.6
	IDFdm2	7 479	620	1 317	6 327	20.8
	MSdk	53 657	1 586	7 777	48 394	16.1
MCR	AT	872	0	415	726	57.2
	ESSFdk	94 305	4 588	12 399	91 404	13.6

APPENDIX III. (Continued).

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
MCR	ESSFwm	16 222	488	1 317	15 483	8.5
	ICHmk1	3 963	20	653	3 687	17.7
	ICHmw2	5 583	29	717	5 451	13.2
	IDFdm2	17 311	650	2 052	15 422	13.3
	MSdk	77 892	2 206	7 662	75 154	10.2
NCM	AT	377 612	1 819	41 401	52 572	78.8
	ESSFvc	145 569	1 101	72 411	88 848	81.5
	ESSFwc2	25 919	249	12 246	15 315	80.0
	ESSFwc4	68 773	1 563	30 853	43 065	71.6
	ESSFwcp	3 445	8	1 175	1 235	95.1
	ESSFwm	37 646	597	15 514	24 520	63.3
	ICHmw1	1 479	0	395	1 299	30.4
	ICHmw2	21 846	522	5 213	16 058	32.5
	ICHmw3	4 342	55	1 138	3 711	30.7
	ICHvk1	47 782	349	25 979	32 553	79.8
	ICHwk1	108 023	749	42 668	80 988	52.7
NOH	AT	155	0	153	155	98.7
	ESSFdc1	10 184	488	3 279	9 857	33.3
	ESSFdcp	422	2	95	320	29.7
	ESSFwc4	24	8	3	24	12.5
	ICHmk1	29 395	2 415	3 370	27 696	12.2
	IDFdm1	94 860	7 031	15 341	81 269	18.9
	IDFxh1	2 566	214	175	1 723	10.2
	MSdm1	80 231	2 988	9 885	77 116	12.8
	PPdh1	52	0	1	6	16.7
SCM	AT	38 745	1 587	15 596	25 178	61.9
	ESSFdk	33	16	0	32	0.0
	ESSFwc4	92 638	2 450	26 753	74 705	35.8
	ESSFwm	110 531	3 955	21 571	98 783	21.8
	ICHdw	115 292	2 024	2 745	71 185	3.9
	ICHmk1	7 417	95	544	5 411	10.1
	ICHmw2	167 670	3 857	16 591	148 558	11.2
	ICHxw	37 380	401	508	9 595	5.3
	MSdk	13 741	0	180	13 223	1.4
SFH	AT	22 076	876	9 380	14 493	64.7
	ESSFdc1	52 458	2 169	17 108	50 028	34.2
	ESSFwc4	104 364	4 946	23 103	97 362	23.7
	ICHdw	171 595	8 832	8 911	121 361	7.3
	ICHmk1	62 428	4 492	4 316	60 286	7.2
	ICHmw2	221 646	13 780	19 062	204 007	9.3
	ICHxw	4 201	57	64	2 720	2.4
	IDFdm1	2 354	42	0	1 696	0.0
	IDFun	3 298	93	1 037	2 288	45.3
	MSdm1	676	0	51	673	7.6

APPENDIX III. (Concluded).

Ecosection	Subzone/ variant	Total Area	Age Class 7	Age Class 8 - 9	Productive Forest Land[b]	Age Class 8 - 9 - Percent of Productive Forest Land[c]
		ha				%
SOH	ICHmk1	3 447	187	1 014	3 281	30.9
	IDFdm1	13 768	611	824	8 447	9.8
	IDFxh1	17 750	950	808	8 876	9.1
	PPdh1	13 752	267	322	2 181	14.8
SPK	AT	237 509	2 045	42 086	55 391	76.0
	ESSFdk	347 438	19 364	122 050	280 099	43.6
	ESSFdkp	1 251	3	259	295	87.8
	ESSFwm	34 065	849	7 541	24 901	30.3
	ICHmk1	19 147	748	2 139	17 489	12.2
	ICHmw1	3 854	104	104	3 654	2.8
	ICHmw2	3	0	0	1	0.0
	IDFdm2	12 507	2 645	1 672	11 385	14.7
	MSdk	119 013	14 799	18 219	112 130	16.2

[a] The values in this table exclude TFL's, parks, and private lands in the Kootenay-Boundary region.

[b] Productive forest land includes age classes 0-9. It does not include nonproductive land such as swamp, alpine, or water.

[c] Percent age classes 8 + 9 = [(age classes 8 + 9)/(productive forest land)] X 100%.

[d] This unit does not contain area capable of yielding productive forests. Tree cover is sporatic and mainly consists of krumholz.

LITERATURE CITED

Achuff, P. L., W. D. Holland, G. M. Coen, and K. Van Tighem (eds). 1984a. Ecological land classification of Kootenay National Park, British Columbia. Vol. I: Integrated resource description. Environment Canada and Alberta Institute of Pedology, Publ. No. M-84-10.

Achuff, P. L., W. D. Holland, G. M. Coen, and K. Van Tighem (eds). 1984b. Ecological land classification of Mount Revelstoke and Glacier National Parks, British Columbia. Vol. I: Integrated resource description. Environment Canada and Alberta Institute of Pedology, Publ. No. M-84-11.

Anonymous. 1993. Interior fish, forestry & wildlife guidelines - Sub-Boreal Mountains and Central Interior Plateau Ecoprovinces. Draft report, August 1993.

Arno, S. F. 1980. Forest fire history in the Northern Rockies. J.For.78:460-465.

Barrett, S. W., S. F. Arno, and C. H. Key. 1991. Fire regimes of western larch - lodgepole pine forests in Glacier National Park, Montana. Can. J. For. Res. 21:1711-1720.

B. C. Ministry of Forests. 1992a. Okanagan Timber Supply Area - intergrated resource management timber harvesting guidelines. B. C. Forest Service, Salmon Arm, Vernon, and Penticton, B. C.

B. C. Ministry of Forests. 1992b. An old growth conservation strategy for the Robson Valley Forest District. B. C. Min. For., McBride, B. C. 47.

B. C. Ministry of Forests. 1992c. An old growth strategy for British Columbia. Report by Old Growth Task Force, May 1992. Queen's Printer, Victoria, B. C.

Braumandl, T. F. and M. P. Curran (compilers and editors). 1992. A field guide for site identification and interpretation for the Nelson Forest Region. B. C. Min. For., Res. Branch, Land. Manage. Handb. No. 20. Victoria, B. C.

Bunnell, F. L. and A. Allaye-Chan. 1987. Potential of winter range reserves for ungulates as habitat for cavity-nesting birds. *In* Fish and wildlife relationships in old-growth forests. W. R. Meehan, T. R. Merrell, and T. A. Hanley (editors.). Proc. of symposium held April 12-15, 1987 at Juneau, Alaska. pp. 357-365.

Carmanah Valley Forest Management Advisory Committee. 1992. Forest management in the upper Carmanah Valley: recommendations of the Public Advisory Committee. Report to the B. C. Ministry of Forests, Victoria, B. C.

Coastal Biodiversity Guidelines Committee. 1992. Guidelines to maintain biological diversity in coastal forests. Draft report. B. C. Min. For. and B. C. Min. of Environ., Lands and Parks.

Demarchi, D. A. 1993. Ecoregions of British Columbia. Map legend plus explanatory notes on Ecoregion Classification System. Ministry of Environment, Lands and Parks, Victoria, B. C.

Demarchi, D. A., R. D. Marsh, A. P. Harcombe, and E. C. Lea. 1990. The environment (of British Columbia). *In* The birds of British Columbia, Vol. 1. R. W. Campbell, N. K. Dawes , I. McTaggart-Cowan, J. M. Cooper, G. W. Kaiser, and C. E. McNazz (eds.). Royal British Columbia Museum, Victoria, B. C. pp. 55-142.

Demarchi, D. A. and E. C. Lea. 1992. Regional and zonal ecosystems in the Shining Mountains. Map and attached legend. B. C. Min. Environ., Lands, and Parks, Wildlife Branch and Montana Dept. of Fish, Wildlife, and Parks. Printed in Victoria, B. C.

Franklin, J. F., K. Cromack, Jr., W. Dension, A. McKee, C. Maser, J. Sedell, F. Swanson, and G. Juday. 1981. Ecological characteristics of old-growth Douglas-fir forests. U. S. Dep. Agric. For. Serv., Gen. Tech. Rep. PNW-118, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Habeck, J. R. 1990. Old-growth ponderosa pine-western larch forests in western Montana: ecology and management. The Northwest Environmental Journal 6:271-292.

Hamilton, E. H. and J. Pojar. 1991. Old growth forests in British Columbia. *In* Proc. of the XIX IUFRO World Congress held 5-11, August 1990 at Montreal, Canada. pp.450-457.

Harmon, M. E., J. F. Franklin, F. J. Swanson, P. Sollins, S. V. Gregory, J. D. Lattin, N. H. Anderson, S. P. Cline, N. G. Aumen, J. R. Sedell, G. W. Lienkaemper, K. Cromack, Jr., and K. W. Cummins. 1986. Ecology of coarse woody debris in temperate ecosystems. Adv. Ecol. Res. 15:133-301.

Harris, L. D. 1984. The fragmented forest - island biogeography theory and the preservation of biotic diversity. The University of Chicago Press.

Hemstrom, M. A. and J. F. Franklin. 1982. Fire and other disturbances of the forests in Mount Rainier National Park. Quaternary Research 18:32-51.

Lewis, P. J. 1993. Personal communication of August 3, 1993.

Lloyd, D., K. Angove, G. Hope, and C. Thompson. 1990. A guide to site identification and interpretation for the Kamloops Forest Region. B. C. Min. For., Kamloops, B. C.

Lunan, J. S. and J. R. Habeck. 1973. The effects of fire exclusion on ponderosa pine communities in Glacier National Park, Montana. Can. J. For. Res. 3:574-579.

Mannan, R. W. and E. C. Meslow. 1984. Bird populations and vegetation characteristics in managed and old-growth forests, northeastern Oregon. J. Wildl. Manage. 48:1219-1238.

Maser, C., R. G. Anderson, K. Cromack, Jr., J. T. Williams, and R. E. Martin. 1979. Dead and down woody material. *In* Wildlife habitats in managed forests - the Blue Mountains of Oregon and Washington. J. W. Thomas (technical editor). U. S. Dep. Agric. For. Serv., Agric. Handb. No. 553, Portland, Oregon. pp 78-95.

Pojar, J. 1991. Old growth forests in British Columbia. *In* Applications in a changing world. H. Schrier, H. S. Brown, P. O'Reilly, and P. Meehan (editors). Proc. of GIS'91 Symposium held February 12-15, 1991 at Vancouver, B. C. pp.15-21.

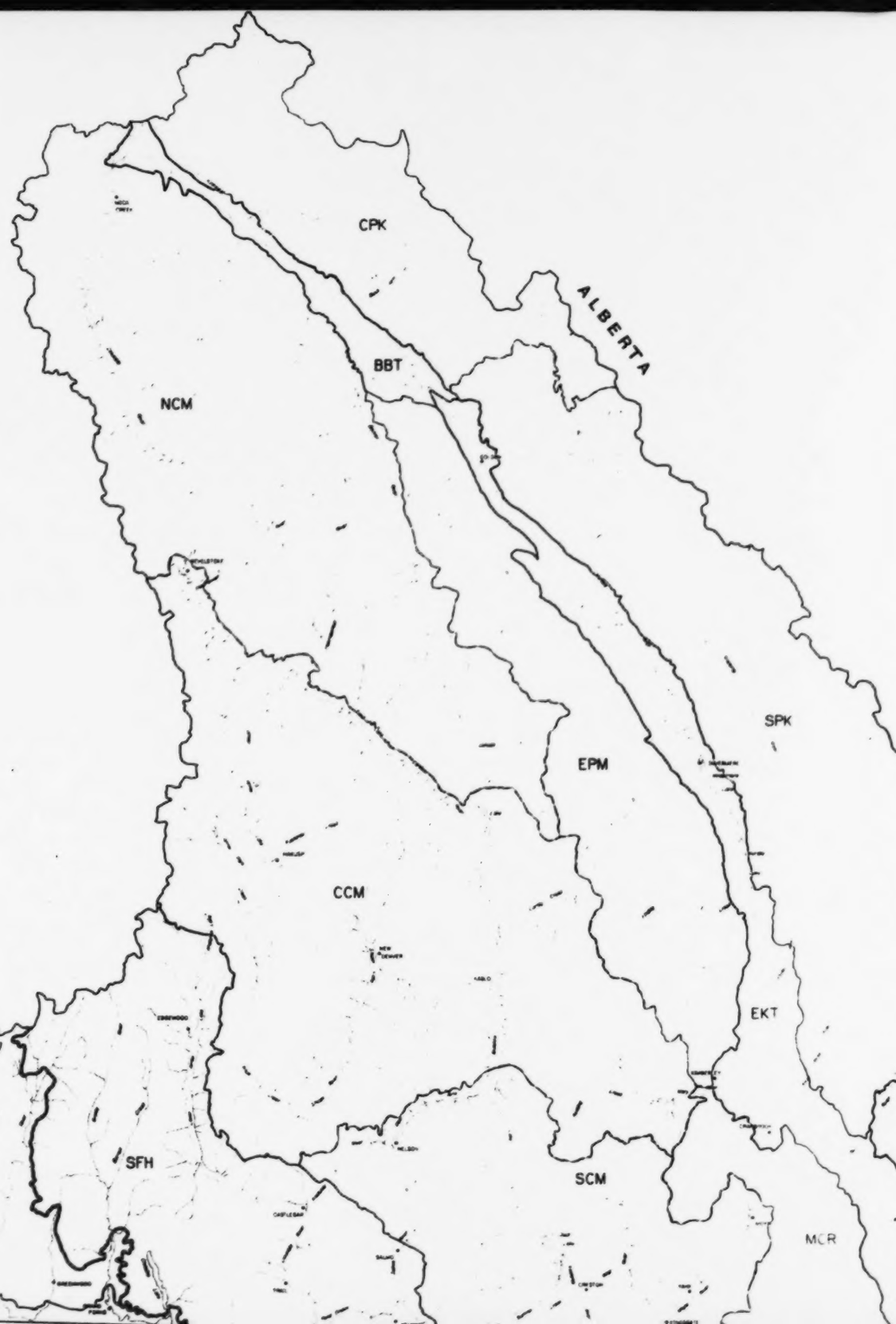
Pojar, J., E. Hamilton, D. Meidinger, and A. Nicholson. 1990. Old growth forests and biological diversity in British Columbia. *In* Landscape ecology and management symposium. G. B. Ingram and M. R. Moss (editors). Held at University of B. C., May 4-5, 1990. Vancouver, B. C. pp. 85-97.

Research Branch. 1990. Old-growth forests: problem analysis. Draft report. B. C. Min. For., Victoria, B. C.

Steeger, C. and M. M. Machmer. 1993. Development of wildlife tree management guidelines for the Nelson Forest Region. Review draft prepared for B. C. Min. For. by Pandion Ecological Research Ltd., Ymir, B. C.

Steventon, J. D. 1992. Managing for biodiversity in the Prince Rupert Forest Region. Draft report. B. C. Min. For., Smithers, B. C.

Thomas, J. W., R. G. Anderson, C. Maser, and E. L. Bull. 1979. Snags. *In* Wildlife habitats in managed forests - the Blue Mountains of Oregon and Washington. J. W. Thomas (technical editor). U. S. Dep. Agric. For. Serv., Agric. Handb. No. 553. Portland, Oregon. pp.60-77.



ECOSECTIONS OF THE KOOTENAY-BOUNDARY REGION

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[illegible]	[illegible]	[illegible]	[illegible]
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	[illegible]	[illegible]	[illegible]
	SELKIRK - BITTERROOT	[illegible]	[illegible]
	NORTHERN	[illegible]	[illegible]
	SOUTHERN	[illegible]	[illegible]
	ROCKY	[illegible]	[illegible]
	MONTANA	[illegible]	[illegible]
	OKANAGAN	[illegible]	[illegible]
	WESTERN	[illegible]	[illegible]
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	TARGET	[illegible]	[illegible]
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